

ORIGINAL ARTICLE OPEN ACCESS

Cross-Cultural Adaptation and Psychometric Validation of the Body Perception Questionnaire-Short Form (BPQ-SF) Among Chinese Patients With Coronary Heart Disease

Jie Chen^{1,2}  | Xiaojuan Chen^{1,2} | Tingting Wu³ | Xiyu Qi³ | Zhongmin Liu² | Jing Chen² | Lijie Zheng² | Yu Chen⁴

¹School of Nursing, Hubei University of Chinese Medicine, Wuhan, China | ²Department of Nursing, Chongqing Jiangjin District Hospital of Traditional Chinese Medicine, Chongqing, China | ³Department of Cardiovascular Diseases, Chongqing Jiangjin District Hospital of Traditional Chinese Medicine, Chongqing, China | ⁴Department of Cardiovascular Diseases, Jiangjin District Central Hospital, Affiliated to Chongqing Medical University, Chongqing, China

Correspondence: Xiaojuan Chen (294973019@qq.com)

Received: 30 June 2025 | **Revised:** 2 July 2025 | **Accepted:** 4 August 2025

Funding: This work was supported by Chongqing Traditional Chinese Medicine Famous Department Construction Project.

Keywords: anxiety | coronary heart disease | interoceptive sensitivity | mental health | reliability | validity

ABSTRACT

Objective: To revise the Brief Body Perception Questionnaire (BPQ-SF) for applicability in patients with coronary heart disease (CHD), and to examine its reliability and psychometric characteristics.

Methods: In Sample 1 ($n = 371$), items from the two subscales of the BPQ-SF were revised using expert consultation and item analysis, followed by exploratory factor analysis (EFA). Sample 2 ($n = 350$) was used for confirmatory factor analysis (CFA) and for evaluating structural validity, internal consistency, test-retest reliability, and criterion-related validity.

Results: The revised BPQ-SF consists of 30 items across two subscales: Body Awareness (15 items) and Autonomic Reactivity (15 items). The scale demonstrated good structural validity, internal consistency, and test-retest reliability. The total score was significantly and positively correlated with anxiety as measured by the Hospital Anxiety and Depression Scale-Anxiety subscale (HADS-A) ($r = 0.368$, $p < 0.01$).

Conclusion: The revised BPQ-SF shows sound reliability and validity in hospitalized patients with CHD and serves as a reliable tool for assessing interoceptive sensitivity and emotional states. It offers a valuable measurement basis for the early detection and intervention of anxiety in patients with coronary heart disease.

1 | Introduction

Coronary Heart Disease (CHD) has become a major global public health issue due to its high prevalence and mortality. According to the Global Burden of Disease Study, an estimated 126 million people worldwide currently live with CHD, and this number continues to rise (Family Medicine et al. 2020). With the rise of the “psycho-cardiology” concept, growing attention has been given to the role of psychological factors in the development and recovery of CHD (Ren et al. 2024). Anxiety is

one of the most common psychological issues among CHD patients, with reported prevalence ranging from 45% to 72% (Diseases National Center For Cardiovascular and China The Writing Committee Of 2024; Elderon et al. 2011). Studies have shown that anxiety significantly affects treatment adherence and quality of life, and is strongly associated with an increased risk of adverse cardiovascular events and mortality (Hohls et al. 2020). Therefore, identifying and managing anxiety in CHD patients is crucial for improving both their mental health and overall quality of life. Although modern psychological

This is an open access article under the terms of the [Creative Commons Attribution-NonCommercial](https://creativecommons.org/licenses/by-nc/4.0/) License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited and is not used for commercial purposes.

© 2025 The Author(s). *International Journal of Methods in Psychiatric Research* published by John Wiley & Sons Ltd.

interventions—such as cognitive behavioral therapy and mindfulness training—have shown some effectiveness, about 25% of patients continue to experience poor outcomes and persistent symptoms, a condition known as “treatment-resistant anxiety.” The long-term efficacy of these interventions remains limited (Zhou and Guo, 2022; Qingxian et al. 2019). Early identification of anxiety risk, understanding its underlying mechanisms, and timely screening are essential for improving treatment outcomes and advancing personalized care strategies.

In recent years, an increasing number of studies have shown that individuals’ perception of internal bodily signals—known as interoception—is closely linked to emotional regulation and is increasingly recognized as both a key mechanism and a potential biomarker for emotional disorders such as anxiety and depression (Murphy 2024; Lee et al. 2024). Interoception refers to the processes by which individuals perceive, interpret, integrate, and regulate signals originating from within the body, such as heart rate, respiration, and gastrointestinal activity. It is generally understood to involve three dimensions: interoceptive accuracy, interoceptive sensibility, and interoceptive awareness (Garfinkel et al. 2015). Among these, interoceptive sensibility refers to the subjective perception of and sensitivity to internal bodily sensations and is typically assessed using self-report questionnaires. According to mind-body interaction models of anxiety, bodily responses and interoceptive predictions play a central role in the onset and maintenance of anxiety. According to mind-body interaction models of anxiety, bodily responses and interoceptive predictions play a central role in the onset and maintenance of anxiety (Quadt et al. 2020; Miniati et al. 2024; Garfinkel et al. 2016; Solano López and Moore 2019). Therefore, assessing interoceptive sensibility is essential for understanding and managing anxiety symptoms. In clinical contexts, evaluating the relationship between interoceptive sensibility and anxiety levels may help determine whether heightened interoceptive sensibility contributes to the development and persistence of anxiety. Establishing such associations may inform future clinical research and practice. Thus, evaluating interoceptive sensibility holds significant potential for early screening and targeted intervention for anxiety.

Currently, the main tools used to assess interoceptive sensibility are the Multidimensional Assessment of Interoceptive Awareness (MAIA) (Mehling et al. 2012) and the Body Perception Questionnaire (BPQ) (Zhou et al. 2024). The MAIA captures multiple dimensions of interoception and is well-suited for research settings. However, its complex structure and lengthy completion time may place a cognitive burden on patients, limiting its clinical applicability. In contrast, the BPQ comprises 122 items across five subscales: body awareness; autonomic nervous system reactivity (supradiaphragmatic and subdiaphragmatic); cognitive-affective-physiological stress responses; stress response patterns; and health history. Its items are simple and easy to understand, making it more appropriate for clinical use. Nevertheless, its length may hinder its use in high-demand healthcare settings (X. Wang et al. 2025). To address this issue, Cabrera et al. (Cabrera et al. 2018) developed the Body Perception Questionnaire–Short Form (BPQ-SF) by extracting key items from the original BPQ. The BPQ-SF contains 46 items and has been translated into several languages. Its psychometric properties have been validated across diverse

populations in different countries (N. Wang et al. 2020; Najari et al. 2024). Wang et al. (N. Wang et al. 2020) translated the BPQ-SF into Chinese and conducted a preliminary psychometric evaluation among Chinese university students. The findings indicated good internal consistency and structural validity of the Chinese version. However, the applicability of the BPQ-SF in clinical populations remains unverified, and significant differences may exist between healthy and clinical samples in terms of scale suitability. This gap has limited the promotion and use of the BPQ-SF for psychological screening in patients with chronic diseases.

Given the high prevalence of anxiety and related psychological disturbances among patients with CHD, as well as the close association between interoceptive sensibility and anxiety symptoms, this study aimed to evaluate the psychometric properties of the Chinese version of the Body Perception Questionnaire–Short Form (BPQ-SF) in hospitalized CHD patients. Specifically, the study assessed the scale’s reliability and validity in a clinical context in China and explored its suitability for this patient population. The findings are expected to provide a scientifically sound and user-friendly assessment tool for the early identification and intervention of anxiety in CHD patients. Furthermore, the results may support the development of personalized psychological management strategies and promote the broader clinical use of interoception-based psychological assessment tools.

2 | Materials and Methods

2.1 | Study Design

This study adopted a cross-sectional design. Data were collected between February and July 2025 in the cardiology ward of a tertiary general hospital in Chongqing, China. Data were collected between February and July 2025 in the cardiology ward of a tertiary general hospital in Chongqing, China (Gagnier et al. 2021). This study was reviewed and approved by the Ethics Committee of Jiangjin District Hospital Affiliated to Chongqing University of Traditional Chinese Medicine. (Approval No. JinZhongLunYanPi 2025-003). The study was conducted in accordance with the Declaration of Helsinki.

2.2 | Participants

A convenience sample was recruited from patients diagnosed with CHD who were admitted to the cardiology department of Jiangjin District Hospital, affiliated with Chongqing University of Traditional Chinese Medicine.

The inclusion criteria were as follows.

1. Diagnosed with atherosclerotic coronary artery disease according to the clinical guidelines for CHD, with a disease duration of at least 3 months;
2. Aged over 18 years;
3. Clinically stable condition;

4. Willingness to participate and ability to provide written informed consent.

Exclusion criteria included.

1. A history of other life-threatening conditions (e.g., advanced cancer, end-stage organ failure, severe respiratory disease, or progressive neurological disorders);
2. Severe psychiatric or cognitive disorders that could impair the ability to comprehend the questionnaire.

2.3 | Sample Size Estimation

The sample size was estimated based on psychometric principles. According to recommendations for exploratory factor analysis (EFA), 5 to 10 participants are required per item (Sousa and Rojjanasirirak 2011). The Chinese version of the BPQ-SF includes 46 items, resulting in a required sample size of 230–460 participants. To account for an expected 10%–20% rate of invalid questionnaires, the final estimated sample size ranged from 253 to 552.

In addition, confirmatory factor analysis (CFA) typically requires a minimum of 200 participants, which was also considered in the study design. A total of 751 valid questionnaires were collected and divided into two independent samples according to the collection period: Sample 1 ($n = 380$), collected from February to March 2025, was used for EFA; Sample 2 ($n = 371$), collected from April to July 2025, was used for CFA. Criterion-related validity was evaluated by examining the correlation between the total score of the Chinese BPQ-SF and the anxiety subscale score of the Hospital Anxiety and Depression Scale (HADS-A). Additionally, 30 participants were randomly selected to complete the Chinese BPQ-SF again after a 2-week interval to assess test–retest reliability.

2.4 | Data Collection and Quality Control

This study employed face-to-face paper-based questionnaire surveys. All investigators received standardized training and instruction prior to data collection. Eligible participants were rigorously screened by the researchers using the electronic medical record system, based on the inclusion and exclusion criteria. Before administering the questionnaire, investigators explained the purpose of the study to the patients to gain their trust and cooperation, and obtained written informed consent. During the survey, investigators provided one-on-one guidance to ensure accurate and complete responses. Completed questionnaires were collected immediately on site.

2.5 | Research Instruments

2.5.1 | General Information Questionnaire

The general information questionnaire was developed by the research team and included demographic and clinical variables

such as age, gender, education level, marital status, type of health insurance, and medical diagnosis.

2.5.2 | Chinese Version of the BPQ-SF

The original BPQ-SF was developed by Cabrera et al. by extracting core items from the full BPQ, resulting in two subscales: Body Awareness and Autonomic Nervous System Reactivity (Cabrera et al. 2018). It was derived from the full BPQ by extracting core items most relevant to clinical research, retaining two subscales: Body Awareness and Autonomic Nervous System Reactivity. The BPQ-SF consists of 46 items in total, with 26 items in the Body Awareness subscale, measuring sensitivity to bodily signals, and 20 items in the Autonomic Nervous System Reactivity subscale, assessing responses of autonomic innervated organs. Each item is rated on a five-point Likert scale ranging from “Never” (1) to “Always” (5), with higher scores indicating greater bodily perception sensitivity. This questionnaire has been translated into multiple languages. Wang et al. (N. Wang et al. 2020) translated the BPQ-SF into Chinese and validated it among Chinese university students, reporting an internal consistency of 0.94 and a test–retest reliability of 0.78.

2.5.3 | HADS-A

The HADS-A (Cassiani-Miranda et al. 2022) was used to assess anxiety symptoms. This scale effectively minimizes bias caused by somatic symptoms and is widely used for screening and assessing anxiety in patients with chronic diseases. The HADS-A consists of seven items, with a reported Cronbach’s alpha of 0.816. Items are scored on a 4-point Likert scale, with anxiety severity categorized as normal (≤ 7), mild to moderate anxiety (8–11), and severe anxiety (≥ 12).

2.6 | Revision of the Questionnaire

Permission for use of the Chinese version of the BPQ-SF was obtained via email correspondence with the original translator. This study invited six nursing experts to conduct two rounds of expert evaluation on the item applicability of the scale: In the first round of expert consultation, the panel unanimously agreed that the items “feeling constipated” and “I am constipated” were semantically similar, and recommended retaining only one. Similarly, the items “frequent swallowing” and “urge to swallow” were considered overlapping, and only one should be retained. To assess content validity, six nursing experts rated the relevance of each item to its corresponding factor using a four-point Likert scale (1 = not relevant, 2 = somewhat relevant, 3 = quite relevant, 4 = highly relevant). The item-level content validity index (I-CVI) and scale-level content validity index (S-CVI) were calculated. Each item was independently reviewed and scored by the experts. Items with an I-CVI < 0.80 were considered for deletion.

Among the six nursing experts, two held senior professional titles, two were associate senior, and two were intermediate-level professionals; all held bachelor’s degrees or higher. To

ensure comprehensibility and acceptability of the items in the clinical setting, cognitive interviews were conducted with 10 patients diagnosed with coronary artery disease. Patients were asked: “Can you understand and accept the content and meaning of each item?” Based on expert review and patient feedback, the final version of the Chinese BPQ-SF was developed.

2.7 | Instrument Validation

2.7.1 | Item Analysis

During item analysis, participants were ranked according to their total questionnaire scores, and the top 27% and bottom 27% were designated as the high-score and low-score groups, respectively. Independent-samples *t*-tests were performed to compare item scores between the two groups. Items with $CR < 3.00$ or $p > 0.05$ were considered to have poor discriminative power and were candidates for deletion. Pearson correlation coefficients were also calculated between each item and the total scale score. Items with a correlation coefficient < 0.300 or $p > 0.05$ were considered insufficiently homogeneous with the overall scale and were also flagged for potential deletion.

2.7.2 | EFA

The I-CVI was calculated to evaluate content validity. An I-CVI greater than 0.80 was considered indicative of adequate content validity. EFA was conducted using principal component analysis with varimax rotation. Prior to the EFA, the Kaiser–Meyer–Olkin (KMO) test of sampling adequacy and Bartlett’s test of sphericity were conducted. A KMO value > 0.80 and a significant Bartlett’s test result ($p < 0.05$) indicated that the data were appropriate for factor analysis. The following criteria were used to identify and exclude inadequate items or factors: Factors with eigenvalues ≥ 1 were retained; Each retained factor was required to contain at least three items; A cumulative variance contribution rate below 50% was considered inadequate; Items with factor loadings or communalities < 0.40 were considered for removal; Items with cross-loadings differing by less than 0.20 across multiple factors were deemed ambiguous and were candidates for removal.

2.7.3 | CFA

CFA was conducted using Sample 2 to evaluate the model fit of the items to their hypothesized dimensions. Model fit was considered acceptable if the following criteria were met: $\chi^2/df < 3.000$; RMSEA < 0.080 ; GFI > 0.90 ; CFI > 0.90 ; TLI > 0.90 .

2.7.4 | Reliability Assessment

Internal consistency was assessed using Cronbach’s α , while test–retest reliability was used to evaluate temporal stability. An acceptable instrument is generally expected to demonstrate a Cronbach’s $\alpha > 0.80$ for the total scale and > 0.60 for each

subscale. A test–retest reliability coefficient exceeding 0.70 indicates good temporal stability.

2.7.5 | Criterion-Related Validity

Previous research has indicated that interoceptive sensibility is a contributing factor to anxiety. Therefore, the criterion-related validity of the BPQ-SF was assessed by examining the correlation between the BPQ-SF total score and the score of the HADS-A.

2.8 | Data Analysis

All questionnaire data were independently double-entered by two researchers using SPSS version 26.0. Statistical analyses were performed using IBM SPSS Statistics 26.0 and AMOS 26.0. For normally distributed continuous variables, data were presented as mean $\pm$ standard deviation ($\bar{x} \pm s$) and compared using independent-samples *t*-tests. For non-normally distributed variables, the median and interquartile range (IQR) were reported. Categorical variables were summarized as frequencies and percentages (%) and analyzed using chi-square (χ^2) tests. All statistical tests were two-tailed, with a significance threshold set at $p < 0.05$.

3 | Results

3.1 | General Characteristics of the Participants

A total of 751 questionnaires were distributed and collected in this study. After excluding 30 invalid responses, 721 valid questionnaires were retained, resulting in a response rate of 96.0%. The demographic and clinical characteristics of the participants are presented in Table 1.

3.2 | Item Analysis

All items in the Body Awareness subscale demonstrated $CR > 3.00$, ranging from 3.410 to 22.083 between high- and low-scoring groups ($p < 0.001$). All items in the Body Awareness subscale demonstrated $CR > 3.00$, ranging from 3.410 to 22.083 between high- and low-scoring groups ($p < 0.001$). Regarding item-total correlations, five items in the Body Awareness subscale—“I breathe quickly,” “Stomach bloating,” “Teeth grinding,” “Urge to defecate,” and “My heart is pounding”—had Pearson correlation coefficients with the total scale score below 0.40 and were consequently removed. The remaining items demonstrated acceptable item-total correlations, ranging from 0.428 to 0.778 ($p < 0.001$). In the Autonomic Nervous System Reactivity subscale, one item—“When I am speaking, I often feel the need to cough or swallow saliva”—had a Pearson correlation coefficient with the total scale score below 0.40 and was therefore removed. The remaining items demonstrated item-total correlations ranging from 0.432 to 0.836 ($p < 0.001$).

TABLE 1 | General characteristics of participants ($n = 721$).

Variable	Sample 1 ($n = 371$, %)	Sample 2 ($n = 350$, %)
Sex		
Male	211 (56.87)	193 (55.14)
Female	160 (43.12)	157 (44.85)
Marital status		
Single	3 (0.80)	0
Married	366 (0.30)	350 (1)
Divorced	1 (0.30)	0
Widowed	1 (0.30)	0
Educational level		
Primary school or below	117 (31.50)	264 (75.42)
Junior high school	249 (67.10)	83 (23.71)
Senior high or above	5 (1.30)	3 (0.85)
Medical insurance		
Urban and rural residents' insurance	314 (84.50)	339 (96.85)
Employee insurance	57 (15.40)	11 (3.14)
Place of residence		
Rural	360 (97.0)	343 (98.00)
Urban	11 (3.00)	7 (0.02)
Monthly income (CNY)		
< 3000	319 (86.00)	339 (96.85)
3000–6000	50 (13.50)	11 (3.14)
6000–9000	2 (0.50)	0

3.3 | Content Validity

Following two rounds of expert consultation, two items—“Feeling constipated” and “Urge to swallow”—were removed. The I-CVI of the remaining items ranged from 0.830 to 1.000, while the S-CVI was 0.800.

3.4 | EFA

EFA was conducted using data from Sample 1. For the Body Awareness subscale, the KMO value was 0.925, and Bartlett's test of sphericity yielded $\chi^2 = 2492.754$, $df = 105$, $p < 0.001$, indicating suitability for factor analysis. Principal component analysis with varimax rotation was used to extract factors with eigenvalues greater than 1. Items were removed if they had factor loadings or communalities below 0.40, items with cross-loadings where the difference between two loadings was less than 0.20, and items with high loadings on multiple factors were removed. After several iterations, four items—“Stomach pain,” “Frequent swallowing,” “Urge to clear throat by coughing,” and “Tearing up”—were deleted. A total of three factors were extracted, explaining 59.410% of the total variance, and 15 items were retained. These factors were labeled as Somatic Perception, Autonomic Arousal Perception, and Anxiety-Related Somatization Perception. The rotated factor loadings are presented in Table 2.

For the Autonomic Nervous Response Subscale, the KMO was 0.870 and Bartlett's test of sphericity showed $\chi^2 = 3393.272$, $df = 105$, $p < 0.001$, indicating appropriateness for factor analysis. Following the same extraction and item selection criteria, four items—“Chest pain,” “Difficulty controlling my eyes,” “Nausea,” and “Constipation”—were removed. A total of four factors were extracted, accounting for 70.157% of the total variance, with 15 items retained. These factors were labeled as Digestive Autonomic Response, Respiratory Autonomic Response, Pharyngeal Autonomic Sensation, and Swallowing-Breathing Coordination Response. The rotated factor loadings are shown in Table 3.

3.5 | CFA

Based on data from Sample 2, CFA was performed using IBM SPSS AMOS 26.0 to evaluate the revised Chinese version of the BPQ-SF. For the Body Awareness Subscale, CFA indicated a good model fit: $\chi^2/df = 2.934$, RMSEA = 0.038, GFI = 0.915, IFI = 0.918, CFI = 0.918. For the Autonomic Nervous Response Subscale, CFA indicated a good model fit: $\chi^2/df = 2.926$, RMSEA = 0.074, GFI = 0.912, IFI = 0.931, CFI = 0.905.

3.6 | Criterion-Related Validity

Pearson correlation analysis showed that the total score of the revised Chinese version of the Brief Body Perception

TABLE 2 | Exploratory factor analysis results of body awareness subscale.

Item (item number)	B1	B2	B3	Communality
7 A swelling of my body or parts of my body	0.570			0.535
9 Muscle tension in my arms and legs	0.639			0.591
10 A bloated feeling because of water retention	0.743			0.711
11 Muscle tension in my face	0.660			0.593
12 I experience goosebumps on my body	0.798			0.668
17 Tremor in my lips	0.751			0.614
23 Difficulty in focusing	0.546			0.469
6 Noises associated with my digestion		0.633		0.468
15 Palm sweating		0.689		0.608
16 Sweat on my forehead		0.582		0.615
18 Sweat in my armpits		0.620		0.637
19 The temperature of my face (especially my ears)		0.764		0.62
3 My mouth being dry			0.541	0.485
21 I feel jittery and on edge			0.813	0.720
22 I feel a strange tingling or cold sensation at the back of my neck, especially when I'm nervous.			0.479	0.578
Eigenvalues	4.251	3.052	1.609	
Cumulative variance Explained (%)	28.341	20.345	10.724	

Abbreviations: B1: Somatic Perception; B2: Autonomic Activation Perception; B3: Anxiety-Related Bodily Sensations.

TABLE 3 | Exploratory factor analysis results of autonomic nervous response subscale.

Item (item number)	S1	S2	S3	S4	Communality
1. I Find it difficult to breathe while eating	0.579				0.768
16 I have acid reflux	0.740				0.570
18 I experience indigestion	0.876				0.851
19 I have digestive issues after eating	0.867				0.844
20 I have diarrhea	0.593				0.500
2 I feel short of breath when eating		0.482			0.502
5 I have shortness of breath		0.806			0.821
6 I find it difficult to breathe while talking		0.880			0.804
13 I feel I cannot get enough air when breathing		0.722			0.679
3 My heartbeat is sometimes irregular			0.572		0.668
8 I cough frequently, interfering with eating or speaking			0.814		0.724
9 I choke or gag on my saliva			0.745		0.714
4 when I eat, food feels dry and sticks to my mouth and throat				0.776	0.734
7 when I eat, I have difficulty coordinating swallowing, chewing, and/or sucking with breathing				0.535	0.630
11 I choke and gag while eating				0.774	0.714
Eigenvalues	3.352	2.736	2.299	2.136	
Cumulative variance Explained (%)	22.349	18.238	15.329	14.242	

Abbreviations: S1: Gastrointestinal Autonomic Reactivity; S2: Respiratory Autonomic Reactivity; S3: Pharyngeal Autonomic Reactivity; S4: Swallowing-Breathing Coordination.

Questionnaire (BPQ-SF) ($\bar{x} \pm s$: 50.29 $\pm$ 11.08) was positively correlated with the total score of the Hospital Anxiety and Depression Scale-Anxiety subscale (HADS-A) (4.94 $\pm$ 2.71) ($r = 0.368$, $p < 0.01$).

3.7 | Internal Consistency

The internal consistency reliability analysis of the revised BPQ-SF showed a Cronbach's alpha coefficient of 0.870 for the total

scale. The Cronbach's alpha was 0.901 for the Body Awareness subscale and 0.817 for the Autonomic Nervous System Reactivity subscale.

3.8 | Test-Retest Reliability

The test-retest reliability of the revised Chinese version of the BPQ-SF was 0.882 for the total scale, 0.907 for the Body Awareness subscale, and 0.814 for the Autonomic Nervous System Reactivity subscale.

4 | Discussion

This study assessed the psychometric properties of the Chinese version of the BPQ-SF in patients with CHD, and revised the scale to provide a reliable instrument for accurately measuring interoceptive awareness in this clinical population. Items with poor discrimination and low item-total correlations were excluded based on two rounds of data collection and statistical analysis. The dimensional structure of the scale was further examined using exploratory factor analysis. Ultimately, 15 items were retained in the Body Awareness subscale and 15 in the Autonomic Nervous System Reactivity subscale, resulting in a final 30-item scale.

Item analysis showed that all items in both subscales demonstrated good discriminatory power ($CR > 3.00$, $p < 0.001$), indicating their effectiveness in distinguishing between patients with different levels of symptom severity. Regarding content validity, the retained items, as determined by expert consultation, demonstrated acceptable I-CVI (I-CVI = 0.830–1.000) and a scale-level CVI (S-CVI) of 0.800, indicating that the scale content sufficiently captures the somatic perception profile of CHD patients. Several items with low correlations with the total score were removed, including “abdominal bloating,” “teeth grinding,” “urge to defecate,” and “feeling constipated.” Specifically, “abdominal bloating” and “teeth grinding” are influenced by vagally mediated visceral sensory inhibition, but are easily affected by dietary habits, medication side effects, or underlying gastrointestinal conditions. Although “urge to defecate” and “feeling constipated” may be pathophysiologically associated with impaired signal integration in the mesenteric plexus due to visceral hypoperfusion in CHD, their manifestation requires a complex ischemia-to-neural signaling cascade and can be confounded by primary gastrointestinal disorders (Kaelberer and Bohórquez 2018). These factors may explain their weak correlation with the overall scale score. Removing these items enhanced the conceptual clarity of the scale by focusing on interoceptive features specific to CHD, thereby improving its discriminatory precision and minimizing the impact of non-specific symptoms.

The results of the EFA revealed a disease-specific structure of interoceptive features in patients with CHD. The Body Awareness subscale ultimately yielded three dimensions—Somatic Perception, Autonomic Arousal Perception, and Anxiety-Related Somatization—whereas the Autonomic Nervous

System Reactivity subscale revealed four distinct domains: Digestive, Respiratory, Pharyngeal, and Swallowing–Breathing Coordination responses. This factor structure diverges from the previously reported three-factor models (Cabrera et al. 2018; Poli et al. 2021; N. Wang et al. 2020; Najari et al. 2024), potentially reflecting alterations in heart–brain feedback circuits characteristic of CHD. The Somatic Perception factor likely reflects spinal-level sensory sensitization, possibly linked to persistent peripheral afferent input driven by myocardial ischemia (Agrimi et al. 2023; Quigg et al. 1988); The Autonomic Arousal Perception factor corresponds to enhanced sympathetic activation, consistent with the cardiac sympathetic afferent reflex theory (Berntson and Khalsa 2021); The Anxiety-Related Somatization factor may represent the emotional amplification of visceral sensations by limbic structures and the anterior cingulate cortex (Alexander et al. 2019; Taggart et al. 2016). Items such as “frequent swallowing” were excluded, potentially due to diminished vagal tone in CHD patients, which may reduce pharyngeal sensory signaling (Lovelace et al. 2023). The four-factor structure of the Autonomic Reactivity subscale allows for a more granular characterization of supra-diaphragmatic autonomic pathways, offering insights into CHD-specific interoceptive phenotypes and informing more tailored approaches to anxiety screening. Notably, the exclusion of the item “chest pain” underscores the specificity of angina-related sensory processing pathways. Patients with CHD may interpret chest pain primarily as a cardiovascular warning signal rather than as an expression of autonomic reactivity (Bonaz et al. 2021). The cardiac interoceptive system integrates mechanical and chemical signals via vagal and sympathetic afferent pathways and plays a central role in cardiovascular homeostasis and disease progression (Moore 2024). Of particular interest is the emergence of the Swallowing–Breathing Coordination factor as an independent domain, which suggests that vagal dysfunction may have unique clinical manifestations in patients with CHD. Therefore, the revised Chinese version of the BPQ-SF may serve as a more promising self-assessment tool for interoceptive functioning in this population.

Criterion-related validity analysis revealed a significant positive correlation between the revised BPQ-SF and anxiety levels, indicating that individuals with heightened interoceptive sensitivity are more prone to experiencing anxiety. This finding is consistent with prior research demonstrating that the onset and progression of anxiety are closely linked to an individual's perception of internal bodily states. This result further supports the mind–body interaction model of anxiety proposed by Mallorquí-Bagué et al. (Mallorquí-Bagué et al. 2016), which highlights the bidirectional interplay between anxiety-related bodily responses and interoceptive predictive processes. According to this model, anxiety emerges through the interaction of both top-down and bottom-up mechanisms. Specifically, in response to external stressors, the brain continuously monitors bodily states and generates interoceptive predictions shaped by pre-existing psychological traits (e.g., beliefs and expectations)—a top-down process (Seth et al. 2011; R. L. Wang and Chang 2024). These predictions are then compared with actual bodily signals arising from bottom-up sensory inputs. A mismatch between predicted and actual interoceptive input leads to a prediction error. In an effort to resolve this error, individuals may develop

a cascade of anxiety-related physiological, emotional, cognitive, and behavioral responses, thereby initiating or intensifying anxiety symptoms (Murphy 2024).

The findings of this study demonstrated that the revised BPQ-SF possesses strong reliability. The total scale showed a Cronbach's α coefficient of 0.870 and a test-retest reliability of 0.882. The Cronbach's α coefficient for the Body Awareness subscale was 0.901, with a test-retest reliability of 0.907, while the Autonomic Nervous System Reactivity subscale had a Cronbach's α of 0.817 and a test-retest reliability of 0.814. These findings indicate that the scale possesses good internal consistency and temporal stability.

Several limitations should be acknowledged in this study. First, the sample was drawn from a single center, which limits the generalizability of the findings to broader populations. Additionally, associations with other negative emotional states were not examined. Future research should investigate the associations and underlying mechanisms between body perception and other adverse psychological states in patients with CHD, in order to strengthen the empirical foundation for targeted interventions to alleviate negative emotions and enhance quality of life. Furthermore, although the BPQ-SF was revised and validated in a CHD population, its applicability to other clinical populations has yet to be established. Further studies are warranted to evaluate the psychometric properties and validity of the scale in populations with other chronic conditions, such as gastrointestinal disorders and diabetes.

5 | Conclusion

In this study, a revised version of the BPQ-SF was developed to assess interoceptive function in patients with CHD. Exploratory and confirmatory factor analyses supported a three-factor structure for the Body Awareness subscale and a four-factor structure for the Autonomic Nervous System Reactivity subscale. The revised BPQ-SF demonstrated robust psychometric properties, indicating its potential as a valid and reliable tool for evaluating interoceptive awareness in patients with CHD.

Author Contributions

Jie Chen: conceptualization, methodology, investigation, data collection, data curation, formal analysis, writing – original draft, writing – review and editing. **Xiaojuan Chen:** conceptualization, validation, formal analysis, investigation, writing – original draft, writing – review and editing, supervision. **Tingting Wu:** methodology, validation, formal analysis, supervision, writing – review and editing. **Xiyu Qi:** methodology, validation, formal analysis. **Zhongmin Liu:** investigation, data collection, validation. **Jing Chen:** methodology, data collection, data curation. **Lijie Zheng:** investigation, data collection, validation. **Yu Chen:** methodology, data collection, data curation.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

All data supporting this study are included in the article and its supplementary materials.

References

- Agrimi, J., D. Menicucci, J. Qu, et al. 2023. “Enhanced Myocardial Adenyllyl Cyclase Activity Alters Heart-Brain Communication.” *JACC Clin Electrophysiol* 9, no. 11: 2219–2235. <https://doi.org/10.1016/j.jacep.2023.07.023>.
- Alexander, L., P. L. R. Gaskin, S. J. Sawiak, et al. 2019. “Fractionating Blunted Reward Processing Characteristic of Anhedonia by Over-Activating Primate Subgenual Anterior Cingulate Cortex.” *Journal of Neuron* 101, no. 2: 307–320. <https://doi.org/10.1016/j.neuron.2018.11.021>.
- Berntson, G. G., and S. S. Khalsa. 2021. “Neural Circuits of Interoception.” *Trends in Neurosciences* 44, no. 1: 17–28. <https://doi.org/10.1016/j.tins.2020.09.011>.
- Bonaz, B., R. D. Lane, M. L. Oshinsky, et al. 2021. “Diseases, Disorders, and Comorbidities of Interoception.” *Trends in Neurosciences* 44, no. 1: 39–51. <https://doi.org/10.1016/j.tins.2020.09.009>.
- Cabrera, A., J. Kolacz, G. Pailhez, A. Bulbena-Cabre, A. Bulbena, and S. W. Porges. 2018. “Assessing Body Awareness and Autonomic Reactivity: Factor Structure and Psychometric Properties of the Body Perception Questionnaire-Short Form (BPQ-SF).” *International Journal of Methods in Psychiatric Research* 27, no. 2: e1596. <https://doi.org/10.1002/mpr.1596>.
- Cassiani-Miranda, C. A., O. Scoppetta, and D. F. Cabanzo-Arenas. 2022. “Validity of the Hospital Anxiety and Depression Scale (HADS) in Primary Care Patients in Colombia.” *General Hospital Psychiatry* 74: 102–109. <https://doi.org/10.1016/j.genhosppsych.2021.01.014>.
- Diseases National Center For Cardiovascular, China The Writing Committee Of. 2024. “Report on Cardi-Ovascular Health and Diseases in China 2023: An Updated Summary.” *Chinese Circulation Journal* 39, no. 7: 625–660. <https://doi.org/10.3969/j.issn.1000-3614.2024.07.001>.
- Elderon, L., K. G. Smolderen, B. Na, and M. A. Whooley. 2011. “Accuracy and Prognostic Value of American Heart Association: Recommended Depression Screening in Patients With Coronary Heart Disease: Data From the Heart and Soul Study.” *Cardiovascular Quality and Outcomes* 4, no. 5: 533–540. <https://doi.org/10.1161/CIRCOUTCOMES.110.960302>.
- Khan, M. A., M. J. Hashim, H. Mustafa, et al. 2020. “Global Epidemiology of Ischemic Heart Disease: Results From the Global Burden of Disease Study.” *Cureus* 12, no. 7: e9349. <https://doi.org/10.7759/cureus.9349>.
- Gagnier, J. J., J. Lai, L. B. Mokkink, and C. B. Terwee. 2021. “COSMIN Reporting Guideline for Studies on Measurement Properties of Patient-Reported Outcome Measures.” *Quality of Life Research* 30, no. 8: 2197–2218. <https://doi.org/10.1007/s11136-021-02822-4>.
- Garfinkel, S. N., A. K. Seth, A. B. Barrett, K. Suzuki, and H. D. Critchley. 2015. “Knowing Your Own Heart: Distinguishing Interoceptive Accuracy From Interoceptive Awareness.” *Biological Psychology* 104: 65–74. <https://doi.org/10.1016/j.biopsycho.2014.11.004>.
- Garfinkel, S. N., C. Tiley, S. O’Keeffe, N. A. Harrison, A. K. Seth, and H. D. Critchley. 2016. “Discrepancies Between Dimensions of Interoception in Autism: Implications for Emotion and Anxiety.” *Biological Psychology* 114: 117–126. <https://doi.org/10.1016/j.biopsycho.2015.12.003>.
- Hohls, J. K., K. Beer, V. Arolt, et al. 2020. “Association Between Heart-Focused Anxiety, Depressive Symptoms, Health Behaviors and Healthcare Utilization in Patients With Coronary Heart Disease.” *Journal of Psychosomatic Research* 131(prepublish): 109958. <https://doi.org/10.1016/j.jpsychores.2020.109958>.

- Kaelberer, M. M., and D. V. Bohórquez. 2018. "Where the Gut Meets the Brain." *Brain Research* 1693, no. Pt B: 127. <https://doi.org/10.1016/j.brainres.2018.04.039>.
- Lee, C. S., S. H. Chu, J. Dunne, et al. 2024. "Body Listening in the Link Between Symptoms and Self-Care Management in Cardiovascular Disease: A cross-sectional Correlational Descriptive Study." *International Journal of Nursing Studies* 156: 104809. <https://doi.org/10.1016/j.ijnurstu.2024.104809>.
- Lovelace, J. W., J. Ma, S. Yadav, et al. 2023. "Vagal Sensory Neurons Mediate the Bezold-Jarisch Reflex and Induce Syncope." *Nature* 623, no. 7986: 387–396. <https://doi.org/10.1038/s41586-023-06680-7>.
- Mallorquí-Bagué, N., A. Bulbena, G. Pailhez, S. N. Garfinkel, and H. D. Critchley. 2016. "Mind-Body Interactions in Anxiety and Somatic Symptoms." *Harvard Review of Psychiatry* 24, no. 1: 53–60. <https://doi.org/10.1097/HRP.0000000000000085>.
- Mehling, W. E., C. Price, J. J. Daubenmier, M. Acree, E. Bartmess, and A. Stewart. 2012. "The Multidimensional Assessment of Interoceptive Awareness (MAIA)." *PLoS One* 7, no. 11: e48230. <https://doi.org/10.1371/journal.pone.0048230>.
- Miao, Z., and X. Guo. 2022. "Effect of Cognitive Behavioral Therapy-Based Dual-Heart Nursing on Anxiety in Patients After Acute Myocardial Infarction." *Practical Journal of Cardiac Cerebral Pneumal and Vascular Disease* 30, no. 1: 108–112. <https://doi.org/10.12114/j.issn.1008-5971.2022.00.006>.
- Miniati, M., M. Lippi, L. Palagini, et al. 2024. "Is Interoception Deficit Linking Alexithymia and Eating Spectrum Symptoms? Study on a Non-Clinical Sample of Young Adults." *Health Care* 12, no. 5: 586. <https://doi.org/10.3390/healthcare12050586>.
- Moore, J. P. 2024. "Interoceptive Signals From the Heart and Coronary Circulation in Health and Disease." *Autonomic Neuroscience* 253: 103180. <https://doi.org/10.1016/j.autneu.2024.103180>.
- Murphy, J. 2024. "Interoception: Where Do We Go From Here?" *Quarterly Journal of Experimental Psychology A* 77, no. 2: 223–229. <https://doi.org/10.1177/17470218231172725>.
- Najari, S., R. Rostami, R. Kazemi, and H. Farahani. 2024. "Factor Structure and Psychometric Properties of the Body Perception Questionnaire-Short Form (BPQ-SF): The Persian Version." *PLoS One* 19, no. 9: e306348. <https://doi.org/10.1371/journal.pone.0306348>.
- Poli, A., A. G. I. Maremmanni, C. Chiorri, et al. 2021. "Item Reduction, Psychometric and Biometric Properties of the Italian Version of the Body Perception Questionnaire-Short Form (BPQ-SF): The BPQ-22." *International Journal of Environmental Research and Public Health* 18, no. 7: 3835. <https://doi.org/10.3390/ijerph18073835>.
- Tu, Q., Q. Jiang, D. N. Liu, et al. 2019. "Characteristics and Psychological Intervention of Depression and Anxiety in Patients With Coronary Heart Disease Before and After PCI Treatment." *Chinese Journal of Gerontology* 39, no. 5: 1230–1232. <https://doi.org/10.1186/s13019-025-03427-5>.
- Quadt, L., G. Esposito, H. D. Critchley, and S. N. Garfinkel. 2020. "Brain-Body Interactions Underlying the Association of Loneliness With Mental and Physical Health." *Neuroscience & Biobehavioral Reviews* 116: 283–300. <https://doi.org/10.1016/j.neubiorev.2020.06.015>.
- Quigg, M., L. G. Elfvin, and H. Aldskogius. 1988. "Distribution of Cardiac Sympathetic Afferent Fibers in the Guinea Pig Heart Labeled by Anterograde Transport of Wheat Germ agglutinin-Horseradish Peroxidase." *Journal of the Autonomic Nervous System* 25, no. 2–3: 107–118. [https://doi.org/10.1016/0165-1838\(88\)90015-x](https://doi.org/10.1016/0165-1838(88)90015-x).
- Ren, Y., H. Tang, L. Zhang, C. Ying, and H. Luo. 2024. "Exploration of Therapeutic Models for Psycho-Cardiology: From Cardiac to Psychological Rehabilitation." *Heliyon* 10, no. 6: e27484. <https://doi.org/10.1016/j.heliyon.2024.10166>.
- Seth, A. K., K. Suzuki, and H. D. Critchley. 2011. "An Interoceptive Predictive Coding Model of Conscious Presence." *Frontiers in Psychology* 2: 395. <https://doi.org/10.3389/fpsyg.2011.00395>.
- Solano López, A. L., and S. Moore. 2019. "Dimensions of Body-Awareness and Depressed Mood and Anxiety." *Western Journal of Nursing Research* 41, no. 6: 834–853. <https://doi.org/10.1177/0193945918798374>.
- Sousa, V. D., and W. Rojjanasrirat. 2011. "Translation, Adaptation and Validation of Instruments or Scales for Use in Cross-Cultural Health Care Research: A Clear and User-Friendly Guideline." *Journal of Evaluation in Clinical Practice* 17, no. 2: 268–274. <https://doi.org/10.1111/j.1365-2753.2010.01434>.
- Taggart, P., H. Critchley, S. van Duijvendoden, and P. D. Lambiase. 2016. "Significance of Neuro-Cardiac Control Mechanisms Governed by Higher Regions of the Brain." *Autonomic Neuroscience* 199: 54–65. <https://doi.org/10.1016/j.autneu.2016.08.013>.
- Wang, N., F. Ren, and X. Zhou. 2020. "Factor Structure and Psychometric Properties of the Body Perception Questionnaire-Short Form (BPQ-SF) Among Chinese College Students." *Frontiers in Psychology* 11: 1355. <https://doi.org/10.3389/fpsyg.2020.01355>.
- Wang, R. L., and R. B. Chang. 2024. "The Coding Logic of Interoception." *Annual Review of Physiology* 86, no. 1: 301–327. <https://doi.org/10.1146/annurev-physiol-042222-023455>.
- Wang, X., Lu Zhai, J. N. Wang, et al. 2025. "Structure, Content and Psychometric Properties of Assessment Tools for Interoceptive Function: A Scoping Review Based on CosmIn and Lcf." *Chinese Journal of Rehabilitation Theory and Practice* 31, no. 2: 172–183. <https://doi.org/10.3969/j.issn.1006-9771.2025.02.007>.
- Zhou, X., F. Ren, S. S. Y. Lui, and R. C. K. Chan. 2024. "Interoception, Somatic Symptoms, and Somatization Tendency in Chinese Individuals With Subsyndromal Depression: A Follow-Up Study." *PsyCh Journal* 13, no. 4: 616–624. <https://doi.org/10.1002/pchj.739>.

Supporting Information

Additional supporting information can be found online in the Supporting Information section.

Supporting Information S1: mpr70035-sup-0001-suppl-data.xls.